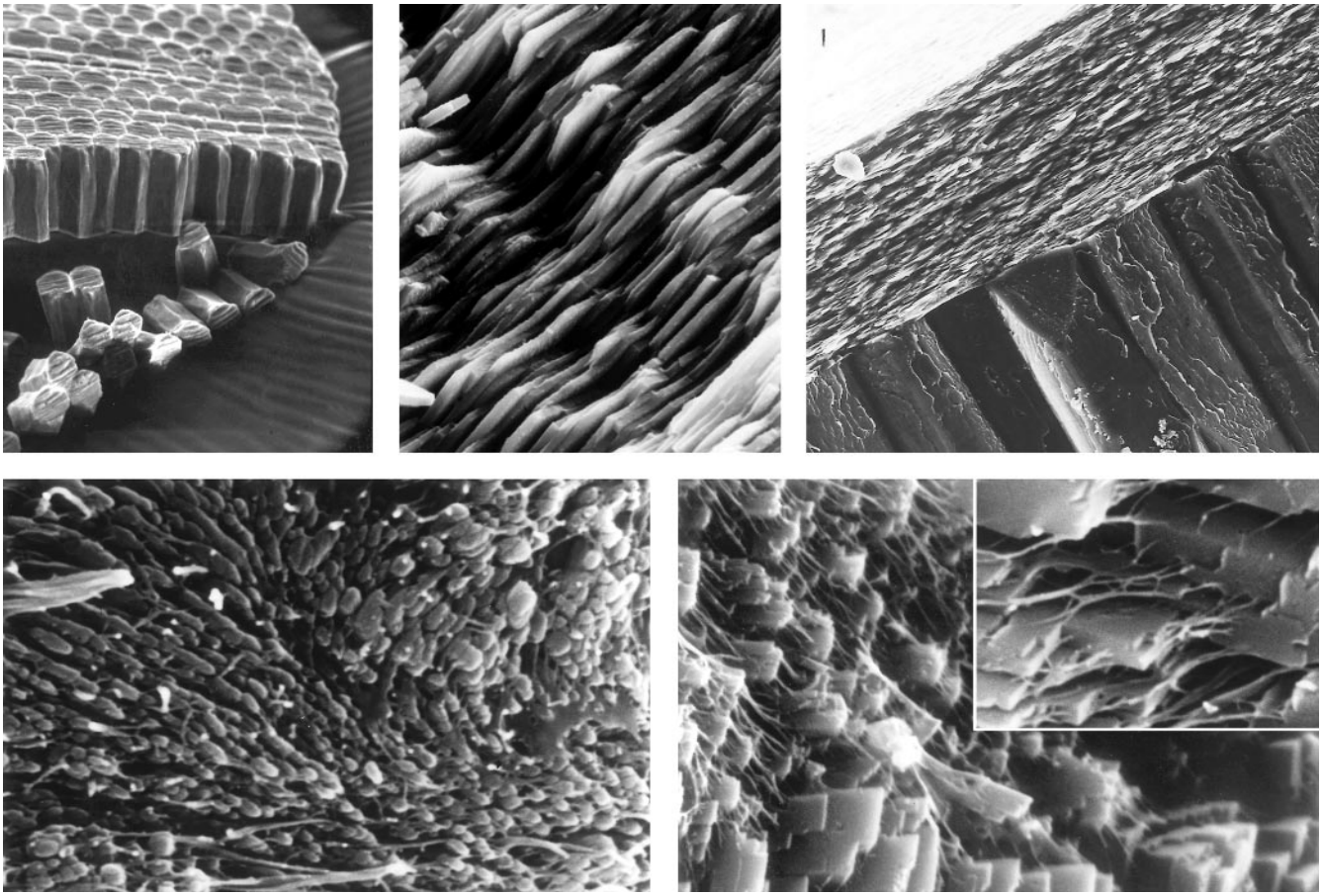
Biology in pictures

See shells anew



Organisms exert remarkable controls over the minerals that form such an important part of their internal or external skeletons. For example, the microenvironment in animals that use calcium carbonate in their shells determines not only where and when crystals form but also which crystalline form, or polymorph, they will be.

As illustrated in the scanning electron micrographs above, the segmented mollusc *Neopilina* has a shell made up of prisms of aragonite (top left), whereas the bivalve mollusc *Atrina serrata* has both nacreous, mother-of-pearl layers of aragonite (top centre) and prisms of calcite (top right). In the test tube, the presence of divalent ions and small molecules can shift the balance between polymorphs. But it is now apparent that — at least in the case of several mollusc species — it is the matrix of proteins and glycoproteins that the animals use as the scaffold for their shells that determines which polymorph is formed *in vivo*.

In experiments performed by Drs L. Addadi S. Weiner, G. Falini and S. Albeck (who kindly provided the photographs) from the Weizmann Institute of Science in Rehovot, Israel, calcium carbonate was precipitated onto a protein matrix in the presence of glycoproteins from various types of mollusc shell. The matrix was made up of the fibrous polysaccharide chitin (from squid pen) and silk (from silk worm cocoon); these are structurally similar to the macromolecules used by molluscs in shell-building, but as they come from non-mineral environments their use avoids the risk of seeding the experiment with any existing crystals. To this matrix were added the soluble, acidic, mollusc shell glycoproteins.

Glycoproteins extracted from an aragonitic shell induced the formation of aragonite crystals (lower left), and those from a prismatic calcite shell induced the formation of calcite (lower right and inset). It should now be possible to identify the glycoproteins responsible for nucleating the different crystal types. For details see G. Falini, S. Albeck, S. Weiner and L. Addadi, *Science* 1996, **217**:67–69.